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AUTHOR Crump, W. Donald; And Others
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ABSTRACT

Subjects 9 to 15 years old were divided into four age levels by 18-month increments to compare learning disabled and normal students on indexes of both oral and written language. Four questions guided the inquiry: (1) Does the syntactic development of oral language differ at the age levels measured? (2) What is the trend of syntactic development in children's oral language? (3) Does the vocabulary development of children's oral language differ at the age levels measured? and (4) What is the trend of vocabulary development in children's oral language? Criteria for identification as learning disabled included an IQ of 80 or above on an intelligence test, not being judged as severely emotionally disturbed, or displaying an achievement discrepancy below 60 percent in oral or written language, basic reading, reading comprehension, or listening comprehension. Films and interviews were used to collect data, which were analyzed separately for oral and written language, using a two-way analysis of variance design. Results for oral language indicated that the syntactic development of learning disabled children is less well developed than that of their peers. For written language, indexes of syntactic development yielded results similar to those for oral language. (MER)

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# APPLICATION OF COMPUTER TECHNOLOGY TO INDEXES OF CHILDREN'S LANGUAGE DEVELOPMENT

By

W. Donald Crump
Area of Special Education
The University of Alabama

Rochelle B. Simms
Department of Human Development
Louisiana State University

Nancy T. Morris
Department of Special Education
Northwestern University of Louisiana

Paper Presented at 1980 Mid-South Educational Research Association Annual Meeting
New Orleans, Louisiana
November 12, 1980

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# APPLICATIONS OF COMPUTER TECHNOLOGY TO INDEXES OF CHILDREN'S LANGUAGE DEVELOPMENT

Language is an important aspect of development in children and youth. Language forms the "code whereby ideas about the world are represented through a conventional system of arbitrary signals for communication" (Bloom & Lahey, 1978, p. 4). Oral language is the primary form of the code and written language represents a more structured, formal aspect of the code. Although scientific studies of language acquisition and development began in the early 1900s, the development of a single, sensitive index of language development has yet to be derived.

Comprehensive reviews of research on normal language development (Andolina, 1978; Ciani, 1974; Fox, 1970; O'Donnell, Griffin, & Norris, 1967) have divided the evolution of this research into three eras: the Traditional Grammar Era, the Structural Grammar Era, and the Transformational Grammar Era. The predominant theories in each era have influenced the design of studies on language and particularly the measurement strategies employed. Just as research has evolved, measurement has evolved from simple methods to quite complex strategies employing computer technology.





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Syntax and vocabulary have been popular topics in the search for sensitive indexes of language development. From initial use of simple word counts and average sentence length, more reliable measures of syntactical and vocabulary development have been developed. Hunt (1965) developed the T-unit as an index of syntactical development. He defined the T-unit as a basic unit of expression consisting of a single main clause and the subordinate clause joined to it (Hunt, 1965, p. 20). Analyzing the written language of school-age children, Hunt found the mean length of a T-unit had minimal overlapping among age groups. O'Donnell, Griffin, & Norris (1967) found the T-unit to be an accurate index of oral and written language development.

More recently, Golub and Frederick (1971) developed a measure of syntactic maturity called the Syntactic Density Score (SDS). Using multivariate analysis, they isolated 10 variables which correlated highly with teacher judgment of children's language. After relative weights were assigned to each variable according to its contribution to syntactic density, the frequency of each variable was counted and weighted. The SDS was derived by totaling the resulting products and dividing by the number of T-units; thus, measures of T-unit length, clause length, number of subordinate clauses, embeddings, and verb expansions were all considered. Golub and Kidder (1974) have developed a computer program to read spontaneous language samples of

students, compute the SDS, and provide scores on the 10 variables comprising the SDS.

Vocabulary development frequently has been measured by the type-token ratio, a ratio of the total number of different words (types) divided by the total number of words (tokens) spoken or written in a child's language sample. Fox (1970) found a consistent increase by grade levels in the mean number of word types spoken. However, Kidder (1974) felt a more complete measure of vocabulary development was needed. She developed an index of vocabulary development called the Vocabulary Intensity Index (VII). Levels of vocabulary difficulty, diversity of vocabulary, number of multisyllabic words, and word-building application comprised the factors in the VII. As with the SDS, a computer program was developed to read spontaneous language samples, compute the VII, and provide scores on the four variables comprising the VII.

Deviations in language development are a primary characteristic of learning disabled students. Oral language and written language are two of seven aspects of development or achievement specified in the guidelines for identification of school-age children and youth with specific learning disabilities (Federal Register, December 29, 1977). A severe discrepancy between expectancy and actual achievement in oral or written language development may serve as a criterion for identification of school-age children and youth as learning disabled. Yet, the majority of research

on language functioning has been directed at the birth to eight-year age range, the period of language acquisition.

Recently, distinctions have been made between research on language acquisition and research on language development. Hunt (1970) pointed out that studies of language acquisition involve small numbers of subjects, emphasize the birth to six-year age range, test hypotheses based on theory, and frequently elicit and analyze specific grammatical structures. Language development studies utilize larger numbers of subjects, emphasize the range beyond age six, analyze spontaneous oral or written language samples, and are designed to inventory and describe language development. A major purpose of language development research is to provide a baseline for normal language development and to provide a basis for comparison of deviations in language development. Since deviations from expectancy form a basis for identification of specific learning disabilities, language development studies are crucial in gaining insight into the language functioning of both normal and learning disabled students, particularly at the intermediate and adolescent age ranges.

## Purpose of Study

Measurement of children's language development has been recognized as a subjective and tedious process. Research in language development as described by Hunt (1970) has been limited by the lack of objective and efficient

measurement techniques. Most designs for research on language development have required a large corpus of material for analysis, and the analysis has been overwhelming in terms of time and tedium.

Computer technology offers an alternative for assessing some aspects of children's language development. The computer can accomplish in seconds what may take days for the language researcher, and the results may be more objective. The Syntactic Density Program and the Vocabulary Intensity Program by Kidder (1974) are two examples of the application of computer programs to indexes of syntactic and vocabulary development.

The purpose of this study was to apply computer technology to compare learning disabled and normal students at four age levels on indexes of both oral and written language. Measures of language development involved the T-unit (Hunt, 1965), the Syntactic Density Score (Golub & Frederick, 1971), the type/token ratio, the corrected type/token ratio (Carroll, 1971), and the Vocabulary Intensity Index (Kidder, 1974). The four age levels were in 18-month increments beginning at 9 years, 1 month, and continuing through age 15 years, 0 months.

Eight questions guided inquiry in this study:

1. Does the syntactic development of learning disabled and normal children's oral language differ at the four age levels as measured by:

(a) the number of T-units?

(b) the average length of T-unit?

(c) the Syntactic Density Score?

2. What is the trend of syntactic development in children's oral language?

3. Does the vocabulary development of children's oral language differ at the four age levels as measured by:

(a) the simple type/token ratio?

(b) the corrected type/token ratio?

(c) the Vocabulary Intensity Index?

4. What is the trend of vocabulary development in children's oral language?

The same four questions were posed for written language development.

## Method and Procedures

The method employed replicated, in part, procedures in other studies on language development of normal children (O'Donnell, Griffin, & Norris, 1967; Fox, 1970; Ciani, 1974) and learning disabled children (Andolina, 1978). A more detailed presentation of the procedure employed is available (Simms & Crump, 1980).

### Subjects

All subjects involved in the study were enrolled in a public school system encompassing suburban and rural areas. Approximately, 13,000 students in kindergarten

through grade 12 were enrolled and approximately 300 students were served in Learning Disabilities Programs.

Criteria for identification as learning disabled for the purposes of this study followed guidelines established by the school system with one exception. Students with discrepancies in only mathematics were eliminated. The following criteria were used:

1. An IQ of 80 or above on the Wechsler Intelligence Scale for Children, or the Stanford-Binet Intelligence Test.

2. Not been judged severely emotionally disturbed and free from primary motor or sensory impairments.

3. Exhibit a severe discrepancy in achievement which falls below 60% of expectancy in any of five areas which include oral language, written language, basic reading, reading comprehension, and listening comprehension.

4. A severe discrepancy between expectancy and achievement was determined as follows:

(a) $E.L. = C.A. \times \frac{IQ}{100} - 5$

(b) Severe discrepancy was calculated in the following manner: S.D. = Achievement Level < 60% of E.L.

Subjects were identified for both the learning disabled and normal groups at four age levels: 9 years, 0 months to 10 years, 6 months; 10 years, 7 months to 12 years, 0 months; 12 years, 1 month to 13 years, 6 months; 13 years, 7 months to 15 years, 0 months. Eighteen white male learning disabled subjects and 18 white male normal

subjects matched for chronological age within 60 days, for Intelligence Quotient (IQ) within 10 points, as well as for school and grade placement were identified for each age level, comprising a total sample of 72 learning disabled and 72 normal children. Table 1 provides the means and standard deviations by cells for IQ. Table 2 provides the means and standard deviations by cells for chronological age in months.

Insert Table 1 about here

Insert Table 2 about here

Data Collection

Two films without narration were used to elicit oral and written language samples. Oral language samples were gathered first. Trained interviewers utilizing standard instructions were employed in both introductory remarks prior to showing the film as well as in collecting the oral language sample. Four subjects, two learning disabled and two normal, were shown films at one time. Care was taken to ensure that interviewers were not aware of the status of the subjects, and assignment of interviewers to subjects was made on a random basis. When subjects arrived at the film room, a standard introduction to the films was employed. Following this, the first film was shown, after which interviewers and subjects went to four different areas for the

oral language samples. Two questions were asked, the first requiring the subject to retell the story and the second requiring him to relate an aspect of the film to his own life. After completion of the samples, subjects and interviewers returned to the film room to see the second film. The procedures for collecting the oral language samples were repeated, and the subjects were returned to their classrooms.

Each interviewer transcribed the tape recordings which he/she had made. The transcriptions were limited to the first 250 words. Next, the transcriptions were typed, and the investigators checked all transcripts against the tape recordings and made corrections. A second check was made to ensure correct punctuation. The final typed transcripts were keypunched on data cards and fed into the computer. The oral language samples were analyzed for syntactic and vocabulary development utilizing the Syntactic Density and Vocabulary Intensity computer programs (Golub & Kidder, 1974).

Written language samples were gathered approximately 6-8 weeks later. Similar procedures were employed with the exception of tape recordings and transcriptions. Written samples were corrected for spelling and punctuation in order to assure correct reading by the computer.

Research Design

A two-way analysis of variance design was utilized separately for oral language and for written language in

this study, with age as one factor and group membership as the other. Tests for trend analysis were used also on the mean scores for age levels to determine if linear, quadratic, or cubic trends were present where significant differences were noted for age levels. Data were analyzed at The University of Alabama employing an analysis of variance program from the Behavioral Sciences Statistics Program Library (Barker & Barker, 1977).

## Results and Discussion

Results revealed no interaction effects of any of the six variables for oral language or six variables for written language. With the oral language variables, main effects for groups were observed for number of T-units. Main effects for age level were noted for the simple type/token ratio and the corrected type/token ratio. Main effects for both groups and age level were observed for the Syntactic Density Score. Trend analysis revealed a significant linear trend across age levels for the Syntactic Density Score and a significant quadratic trend for the corrected type/token ratio.

With the written language variables, main effects for groups and age levels were observed for number of T-units, the SDS, and the corrected type/token ratio. Main effects for age level were noted for average length of T-unit. Trend analysis revealed a significant linear trend across age levels for average length of T-unit, SDS, and corrected

type/token ratio. A significant quadratic trend was observed for number of T-units. The following sections discuss these results separately for oral and written language.

Oral Language

Number of T-units. Analysis of variance conducted on raw scores for number of T-units indicated significant main effects for groups (see Table 3).

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Insert Table 3 about here

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Means for column effects (see Table 4) showed that learning disabled students produced, on the average, 2.77 more T-units than did their normal peers. Examination of the cell means in Table 4 indicated that learning disabled students produced more T-units than normal students at each of the four age levels. The importance of these results must be considered in relation to the results for mean length of T-unit.

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Insert Table 4 about here

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Mean length of T-unit. Analysis of variance conducted on mean length of T-unit disclosed no main effects for either groups or age levels (see Table 5). Although significance

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Insert Table 5 about here

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was not achieved, it should be noted that inspection of the cell means indicated that, at each age level, normal

children produced longer T-units than learning disabled children (see Table 6). The nonsignificant differences between the two groups were slight at age levels one (.16) and two (.03) but greater at age levels three (.40) and four (.67).

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Insert Table 6 about here

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Syntactic Density Score. Analysis of variance conducted on Syntactic Density Scores indicated significant effects for both groups and age levels (see Table 7). Differences were noted consistently between groups and across all four age levels. Means for group effects (see Table 8) showed that normal children achieved Syntactic Density Scores that were .18 higher than the scores achieved by learning disabled children.

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Insert Table 7 about here

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Insert Table 8 about here

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According to the grade level conversion table for the Syntactic Density Score, this difference would be the equivalent of 3.6 months or slightly over one-third of a grade level. An examination of cell means in Table 9 revealed that differences between the two groups were not as great at age levels one (.10) and two (.07) as they were at age

levels three (.18) and four (.36). This was consistent with the pattern of differences found in mean length of T-unit. Syntactic Density Scores increased from age level one to age level three with a slight decline at age level four for the learning disabled group. The normal group increased consistently from youngest to oldest age level.

As noted in Table 9, trend analysis across the four age groups showed a significant linear trend in the data. As age level means in Table 9 indicate, the gains are somewhat consistent with slight leveling at the oldest age level.

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Insert Table 9 about here

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Simple type/token ratio. Results for the simple type/token ratio indicated significant main effects only for age levels (see Table 10). Examination of age level

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Insert Table 10 about here

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means in Table 11 revealed that the highest ratio (.40) was achieved by the youngest age level. Age level two reflected a considerable regression (.03) followed by a negligible increase at age level three and a considerable increase (.03) at age level four. Cell means indicated that both groups displayed similar patterns; however, the regression from level one to two was much greater in the normal group.

Insert Table 11 about here

Corrected type/token ratio. Results indicated significant main effects for age levels (see Table 12). A pattern consistent with that found in the simple type/token ratio was found: There was a decrease in scores from age levels one to two, a moderate increase from two to three, and a greater increase from three to four (see Table 13). Trend analysis was conducted across the four age levels on the corrected type/token ratio. As Table 14 indicates, a significant quadratic trend was observed.

Insert Table 12 about here

Insert Table 13 about here

Insert Table 14 about here

Vocabulary Intensity Index. Analysis of variance conducted on Vocabulary Intensity Index scores indicated that there were no main effects for either groups or age levels (see Table 15). Although significanct was not found, it should be noted that the pattern found in the other three measures of vocabulary development--namely, a decrease between age levels one and two followed by increases at subsequent age levels--was found (see Table 16).

Examination of cell means indicated a plateau for learning disabled subjects at the fourth age level.

Insert Table 15 about here

Insert Table 16 about here

Written Language

Number of T-units. Significant main effects for age and groups were noted (see Table 17). As indicated by the

Insert Table 17 about here

cell means in Table 18, the normal students produced an average of 4.6 more T-units per passage than the learning disabled students. Normal students produced the greater number of T-units per passage at all four age levels. In

Insert Table 18 about here

both groups, the number of T-units per passage increased across the first three age levels and declined at the fourth level.

A trend analysis for the significant differences among the age levels revealed a significant quadratic trend. A summary of the trend analysis is shown in Table 19.

Insert Table 19 about here

Length of T-unit. Analysis of variance indicated a significant main effect for age level (see Table 20). An examination of cell means shown in Table 21 indicates that

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Insert Table 20 about here

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Insert Table 21 about here

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the average length of a T-unit increased steadily across age levels for both the normal and learning disabled students.

A trend analysis on the main effect of age found a significant linear trend indicating length of T-unit did increase steadily with age. A summary of the trend analysis is presented in Table 22.

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Insert Table 22 about here

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Syntactic Density Score. Because the length of passage varied across age levels and between groups, it was necessary to correct the Syntactic Density Score. The correction procedure described by Belanger (1978) was applied to these data. The analysis of variance on the Syntactic Density Score revealed significant main effects for age and group. A summary of the analysis of variance is presented in Table 23. As indicated by the cell means in Table 24, the mean corrected Syntactic Density Score

increased across age levels for both groups. At each age level, the normal students had a greater mean corrected Syntactic Density Score. The trend analysis on the main effect of age revealed a significant linear trend. Table 25 is a summary of the trend analysis.

Insert Table 23 about here

Insert Table 24 about here

Insert Table 25 about here

Simple type/token ratio. Analysis of variance revealed no significant effects for age or group. Cell means are shown in Table 26. As indicated, all cell means were close to the grand mean of .43.

Insert Table 26 about here

Corrected type/token ratio. Analysis of variance indicated significant main effects for both age level and groups (see Table 27). As may be seen by an inspection of

Insert Table 27 about here

the cell means in Table 27, the mean corrected type/token ratio increased across age levels for both normal and

learning disabledstudents. At each age level, the mean corrected type/token ratio was greater for the normal students than for the learning disabled students. Trend analysis on the main effect of age indicated a significant linear trend for the corrected type/token ratio. A summary of the trend analysis is shown in Table 29.

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Insert Table 28 about here

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Insert Table 29 about here

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Vocabulary Intensity Index. No significant main effects for age levels or groups were observed for the Vocabulary Intensity Index. As may be seen from the inspection of Table 30, the cell means varied only slightly about the grand mean of .88.

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Insert Table 30 about here

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## Conclusions

The results of this study were viewed separately for oral language and written language. For oral language, the results indicated that the syntactic development of learning disabled children is less well developed than their peers as measured by number of T-units and Syntactic Density Score. Average T-unit length did not distinguish groups. Measures of vocabulary development also did not distinguish

groups on oral language development. Significant differences among age levels were noted for the Syntactic Density Score, the simple type/token ratio, and the corrected type/token ratio.

For written language, indexes of syntactic development yielded results similar to those for oral language. Learning disabled students significantly lagged behind normal students on number of T-units and the Syntactic Density Score. Again, average length of T-unit did not distinguish the two groups. However, significant differences among age levels were noted for all measures of syntactic development, indicating their possible utility in research on language development. The corrected type/token ratio yielded significant differences in vocabulary development between learning disabled and normal students, a difference not noted for oral language. Learning disabled subjects lagged behind their normal peers. Also, this measure of vocabulary development was sensitive to differences across age levels, indicating its potential for use in research in language development.

In conclusion, research on language development has changed dramatically in the last 50 years. Evolution of theories about language have had a profound influence on measurement. The sizeable language corpus required for analysis has been a major barrier to research. With the use of computer technology, the subjectivity and tedium

required in language research are minimized. A major implication of this study is that computer technology can be applied to samples of written and oral language and that several viable indexes of syntactic and vocabulary development presently exist.

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Table 1

Means and Standard Deviations for Intelligence Quotient

| | Learning disabled | | | Normal | | |
|---|---|---|---|---|---|---|
| Age levels | N | M | SD | N | M | SD |
| 9.0-10.5 | 18 | 94.94 | 8.07 | 18 | 97.10 | 7.83 |
| 10.6-12.0 | 18 | 93.22 | 6.35 | 18 | 93.83 | 7.83 |
| 12.1-13.5 | 18 | 96.94 | 8.48 | 18 | 97.22 | 9.25 |
| 13.6-15.0 | 18 | 94.33 | 6.96 | 18 | 95.61 | 7.12 |

Table 2

Means and Standard Deviations for Chronological Age in Months

| | Learning Disabled | | | Normal | | |
|---|---|---|---|---|---|---|
| Age levels | N | M | SD | N | M | SD |
| 9.0-10.5 | 18 | 116.89 | 5.13 | 18 | 116.39 | 5.49 |
| 10.6-12.0 | 18 | 134.83 | 7.95 | 18 | 135.06 | 8.03 |
| 12.1-13.5 | 18 | 150.94 | 3.66 | 18 | 150.56 | 4.10 |
| 13.6-15.0 | 18 | 169.00 | 5.73 | 18 | 169.00 | 5.48 |

Table 3

Analysis of Variance for Number of T-units

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | 125.11 | 3 | 41.70 | .61 | .61 |
| Groups | 277.78 | 1 | 277.78 | 4.06 | .04* |
| Age x Groups | 113.56 | 3 | 37.85 | .55 | .65 |
| Within cell | 9,313.56 | 136 | 68.48 | | |
| Total | 9,830.00 | 143 | | | |

*$p < .05$

Table 4

Means for Cells, Groups, and Age Levels for Number of T-units

| Age levels | L.D. | Normal | Age level means |
|---|---|---|---|
| 1 | 38.44 | 33.33 | 35.89 |
| 2 | 38.61 | 37.61 | 38.11 |
| 3 | 36.61 | 35.50 | 36.06 |
| 4 | 37.89 | 34.00 | 35.94 |
| Group means | 37.89 | 35.11 | |

Table 5

Analysis of Variance for Mean Length of T-unit

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | 6.99 | 3 | 2.33 | 1.22 | .30 |
| Groups | 3.58 | 1 | 3.58 | 1.87 | .17 |
| Age x Groups | 2.18 | 3 | .73 | .38 | .76 |
| Within Cell | 259.30 | 136 | 1.71 | | |
| Total | 272.05 | 143 | | | |

Table 6

Means for Cells, Groups, and Age Levels for Mean Length of T-unit

| Age levels | L.D. | Normal | Age level means |
|---|---|---|---|
| 1 | 7.44 | 7.60 | 7.52 |
| 2 | 7.41 | 7.44 | 7.43 |
| 3 | 7.70 | 8.10 | 7.90 |
| 4 | 7.58 | 8.25 | 7.91 |
| Group means | 7.54 | | |

Table 7

Analysis of Variance for Syntactic Density Score

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | 2.01 | 3 | .67 | 3.174 | .026* |
| Groups | 1.17 | 1 | 1.17 | 5.57 | .019* |
| Age x Groups | .44 | 3 | .15 | .70 | .558 |
| Within cell | 28.64 | 136 | .21 | | |
| Total | 32.26 | 143 | | | |

*p < .05

Table 8

Means for Cells, Groups, and Age Levels for Syntactic Density Score

| Age levels | L.D. | Normal | Age level means |
|---|---|---|---|
| 1 | 1.62 | 1.73 | 1.68 |
| 2 | 1.76 | 1.84 | 1.80 |
| 3 | 1.84 | 2.02 | 1.93 |
| 4 | 1.80 | 2.16 | 1.98 |
| Group means | 1.76 | 1.94 | |

Table 9

Trend Analysis for Syntactic Density Score Across Four Age Levels

| Source | MS | MS | F |
|---|---|---|---|
| Age | 3 | .67 | 3.17* |
| Linear | 1 | 1.89 | 8.95* |
| Quadratic | 1 | .04 | .21 |
| Cubic | 1 | .01 | .07 |
| Within | 136 | .21 | |

*p < .05

Table 10

Analysis of Variance for Simple Type-Token Ratio

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | .02 | 3 | .01 | 2.63 | .05* |
| Groups | .00 | 1 | .00 | .07 | .79 |
| Age x Groups | .01 | 3 | .00 | 1.16 | .32 |
| Within cell | .35 | 136 | .00 | | |
| Total | .38 | 143 | | | |

*p ≤ .05

Table 11

Means for Cells, Groups, and Age Levels for Simple Type-Token Ratio

| Age levels | L.D. | Normal | Age level means |
|---|---|---|---|
| 1 | .39 | .41 | .40 |
| 2 | .38 | .37 | .37 |
| 3 | .39 | .37 | .38 |
| 4 | .40 | .40 | .40 |
| Group means | .39 | .39 | |

Table 12

Analysis of Variance for Corrected Type-Token Ratio

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | 2.61 | 3 | .87 | 4.12 | .008* |
| Groups | .20 | 1 | .20 | .95 | .667 |
| Age x Groups | .40 | 3 | .13 | .63 | .603 |
| Within cells | 28.79 | 136 | .21 | | |
| Total | 32.00 | 143 | | | |

*$p < .01$

Table 13

Means for Cells, Groups, and Age Levels for Corrected Type-Token Ratio

| Age levels | L.D. | Normal | Age level means |
|---|---|---|---|
| 1 | 4.62 | 4.61 | 4.61 |
| 2 | 4.30 | 4.36 | 4.33 |
| 3 | 4.52 | 4.32 | 4.42 |
| 4 | 4.73 | 4.58 | 4.65 |
| Group means | 4.54 | 4.46 | |

Table 14

Trend Analysis for Corrected Type-Token Ratio Across Four Age Levels

| Source | df | MS | F |
|---|---|---|---|
| Age | 3 | .87 | 4.12* |
| Linear | 1 | .10 | .49 |
| Quadratic | 1 | 2.45 | 11.49* |
| Cubic | 1 | .09 | .41 |
| Within | 136 | .21 | |

*$p < .01$

Table 15

Analysis of Variance for Vocabulary Intensity Index

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | .04 | 3 | .01 | 1.24 | .299 |
| Groups | .00 | 1 | .00 | .11 | .740 |
| Age x Groups | .03 | 3 | .01 | 1.07 | .364 |
| Within cell | 1.31 | 136 | .01 | | |
| Total | 1.37 | 143 | | | |

Table 16

Means for Cells, Groups, and Age Levels for Vocabulary Intensity Index

| Age levels | L.D. | Normal | Age level means |
|---|---|---|---|
| 1 | .86 | .88 | .87 |
| 2 | .84 | .87 | .86 |
| 3 | .89 | .84 | .86 |
| 4 | .89 | .91 | .90 |
| Group means | .87 | .88 | |

Table 17

Analysis of Variance for Number of T-units

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | 526.47 | 3 | 175.49 | 3.68 | <.014 |
| Groups | 765.44 | 1 | 765.44 | 16.03 | <.001 |
| Age x Groups | 153.39 | 3 | 51.13 | 1.07 | .364 |
| Within cells | 6,492.67 | 136 | 47.74 | | |
| Total | 7,937.97 | 143 | | | |

Table 18

Means for Cells, Groups, and Age Levels for Number of T-units

| | Learning Disabled | Normal | Age level means |
|---|---|---|---|
| 1 | 13.00 | 16.44 | 14.72 |
| 2 | 13.72 | 20.00 | 16.86 |
| 3 | 16.06 | 22.94 | 19.50 |
| 4 | 14.06 | 15.89 | 14.97 |
| Group Means | 14.21 | 18.82 | |

Table 19

Trend Analysis for Number of T-units
Across Four Age Levels

| Source | df | MS | F | p |
|---|---|---|---|---|
| Age | 3 | 175.49 | 3.68 | .014 |
| Linear | 1 | 20.89 | .44 | NS |
| Quadratic | 1 | 404.45 | 8.47 | < .01 |
| Cubic | 1 | 106.96 | 2.24 | NS |
| Within cells | 136 | | | |

Table 20

Analysis of Variance for Length of T-unit

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | 227.70 | 3 | 75.90 | 16.00 | < .001 |
| Groups | 12.50 | 1 | 12.50 | 2.63 | .103 |
| Age x Groups | 27.85 | 3 | 9.28 | 1.96 | .122 |
| Within cells | 644.95 | 36 | 4.74 | | |
| Total | 912.99 | 143 | | | |

Table 21

Means for Cells, Groups, and Age Levels for Mean Length of T-unit

| | Learning Disabled | Normal | Age level means |
|---|---|---|---|
| 1 | 7.40 | 7.45 | 7.42 |
| 2 | 7.67 | 8.81 | 8.24 |
| 3 | 9.06 | 8.53 | 8.80 |
| 4 | 9.98 | 11.68 | 10.83 |
| Group Means | 8.53 | 9.12 | |

Table 22

Trend Analysis for Length of T-unit Across Four Age Levels

| Source | df | MS | F | p |
|---|---|---|---|---|
| Age | 3 | 75.90 | 16.00 | $<.001$ |
| Linear | 1 | 211.67 | 44.66 | $<.001$ |
| Quadratic | 1 | 13.27 | 2.80 | NS |
| Cubic | 1 | 5.44 | 1.15 | NS |
| Within cells | 136 | | | |

Table 29

Trend Analysis for Corrected Type/Token Ratio Across Four Age Levels

| Source | df | MS | F | p |
|---|---|---|---|---|
| Age | 3 | 3.23 | 12.97 | <.001 |
| Linear | 1 | 9.63 | 38.63 | <.001 |
| Quadratic | 1 | .091 | .37 | NS |
| Cubic | 1 | .164 | .66 | NS |
| Within cells | 136 | | | |

Table 30

Means for Cells, Groups, and Age Levels for Vocabulary Intensity Index

| | Learning Disabled | Normal | Age level means |
|---|---|---|---|
| 1 | .84 | .88 | .86 |
| 2 | .89 | .87 | .88 |
| 3 | .86 | .86 | .86 |
| 4 | .89 | .90 | .90 |
| Group Means | .87 | .88 | |

Table 27

Analysis of Variance for Corrected Type/Token Ratio

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | 9.69 | 3 | 3.23 | 12.97 | <.001 |
| Groups | 6.39 | 1 | 6.39 | 25.63 | <.001 |
| Age x Groups | 1.31 | 3 | .44 | 1.75 | .158 |
| Within cells | 33.88 | 136 | .25 | | |
| Total | 51.27 | 143 | | | |

Table 28

Means for Cells, Groups, and Age Levels for Corrected Type/Token Ratio

| | Learning Disabled | Normal | Age level means |
|---|---|---|---|
| 1 | 2.91 | 3.27 | 3.09 |
| 2 | 3.10 | 3.76 | 3.43 |
| 3 | 3.49 | 3.64 | 3.57 |
| 4 | 3.54 | 4.07 | 3.81 |
| Group Means | 3.26 | 3.68 | |

Table 23

Analysis of Variance for Corrected Syntactic Density Score

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Age | 50.92 | 3 | 16.97 | 20.17 | <.001 |
| Groups | 7.01 | 1 | 7.01 | 8.33 | <.005 |
| Age x Groups | 4.09 | 3 | 1.36 | 1.62 | .186 |
| Within cells | 114.46 | 136 | .84 | | |
| Total | 176.48 | | | | |

Table 24

Means for Cells, Groups, and Age Levels for Corrected Syntactic Density Score

| | Learning Disabled | Normal | Age level means |
|---|---|---|---|
| 1 | 1.93 | 2.02 | 1.98 |
| 2 | 2.03 | 2.83 | 2.43 |
| 3 | 2.70 | 2.83 | 2.76 |
| 4 | 3.23 | 3.98 | 3.60 |
| Group Means | 2.47 | 2.91 | |

Table 25

Trend Analysis for Corrected Syntactic Density Score Across Four Age Levels

| Source | df | MS | F | p |
|---|---|---|---|---|
| Age | 3 | 16.97 | 20.17 | <.001 |
| Linear | 1 | 48.98 | 58.31 | <.001 |
| Quadratic | 1 | 1.38 | 1.64 | NS |
| Cubic | 1 | .722 | .86 | NS |
| Within cells | 136 | | | |

Table 26

Means for Cells, Groups, and Age Levels for Simple Type/Token Ratio

| | Learning Disabled | Normal | Age level means |
|---|---|---|---|
| 1 | .45 | .45 | .45 |
| 2 | .45 | .43 | .44 |
| 3 | .43 | .39 | .41 |
| 4 | .45 | .45 | .44 |
| Group Means | .44 | .43 | |